

## Original Article

### Spectrum of Electroencephalographic Findings in Seizures under 6 months aged infants at a Tertiary Care Hospital

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#### ABSTRACT

**Objectives:** To determine the spectrum of electroencephalographic findings in epilepsy of infants under 6 months of age

**Methodology** It was a cross-sectional study conducted in the Pediatrics Department, at Shaikh Zayed Hospital, Lahore from May 2018 till April 2019. One hundred and forty-two infants aged one to six months of both genders which were newly diagnosed having first episode of seizures recruited by non-probability purposive sampling. Infants with no seizures, any central nervous system abnormalities like meningomyelocele, spina bifida, encephalocele, microcephaly and already taking antiepileptic drugs were excluded. Patient's demographic characteristics, seizure pattern and EEG record was obtained on Performa. Frequencies and percentages were calculated.

**Results:** The mean age of infant patients was  $3.18 \pm 1.90$  months (1-6 months). Of the 142 infant patients, 97 (68%) were male and 45 (32%) females with positive family history in 42 (30%) patients. Epilepsy pattern revealed 101 (71.1%) presented with generalized seizures while 23 (16.2%) had focal seizures. Only 1 (0.7%) child suffered from epilepsy syndromes while seventeen (12%) had unclassified seizures. EEG reporting showed 41 (29%) had abnormal tracing. Of these, 23 (16%) patients had abnormal focal while 15 (11%) had abnormal generalized frequency and only 3 (2%) were with undetermined reporting. Normal EEG was seen in 101 (71%) patients.

**Conclusion:** Almost one third of patients with epilepsy had abnormal EEG findings so antiepileptic therapy selection must be tailored on individual basis, with special focus on patient's history and clinical presentation.

**KEYWORDS:** Epilepsy, Electroencephalogram, Generalized and Focal Seizure.

## INTRODUCTION

Epilepsy is a chronic brain condition in which recurrent fits affect cognitive, psychological, neurobiological, and social function.<sup>1</sup> There are recurrent and unprovoked seizures which may be generalized or focal associated with loss of consciousness

and bowel, bladder dysfunction. Different studies revealed variable incidence of epilepsy worldwide.<sup>2</sup> Epilepsy affects 0.5%-1% of the children, incidence varies from high income to low middle income countries.<sup>3</sup> In Bangladesh, it is estimated to be 8.2/1000 (95% CI 3.4-13.0) in children aged <18 years<sup>4</sup> whereas Pakistan showed up to 9.99 / 1000 population.<sup>5</sup> The electroencephalogram (EEG) is the procedure for detecting brain waves which showed electrical activity of the brain using leads made up of metallic electrodes which records different types of lines/waves on paper.<sup>6</sup> There are four types of EEG waves: Alpha, beta, theta, and delta. Frequency of alpha waves is 9-11 cycles per second which are present in the awake and in resting states of the brain. Beta waves are of 14 to 80 cycles per second which are predominant in increased mental activity. The frequency of theta waves are 4 to 7 cycles per second, most prominent in children and abnormally present in the excessive form during encephalopathy and degenerative brain diseases of children. Delta waves are of 3.5 cycles per second which are present in deep sleep, organic brain diseases, comatose patient, and

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severe brain damage.<sup>7</sup> We can also diagnose different forms of encephalitis and vasculitis.<sup>8</sup>

About 50% of the children undergo EEG to diagnose epilepsy but 10% of epilepsy patients never show abnormal discharge and 2-5% have abnormal centro-temporal discharges which are sometimes diagnosed as epilepsy. To rule out these false positive and negative results, video EEG and 24 hour EEG recording should be preferred but these are expensive and time consuming procedures.<sup>9</sup> According to the EEG, epilepsy is divided into two classes by the “International Classification of Epileptic Syndromes and Epilepsies”. The first one is partial or focal versus systemic, and idiopathic versus cryptogenic or symptomatic.<sup>5</sup> Another classification done by ILAE Seizure Classification shows three types of seizures. One is generalized which involves both hemispheres. Sometimes some or all the parts of both hemispheres show abnormal discharges of high voltage on both sides. Focal seizures refer to the one side of the brain. On EEG which appears in the form of high amplitude waves of a specific area. Epileptic Syndrome on the basis of clinical history, abnormal neck movements slam sign, abnormal twitching of eyes, guttering sounds/noises, fits associated with cyanosis and pallor. Undetermined is another form of seizures in which no specific areas are involved and on EEG the findings are consistent with generalized or focal.<sup>10</sup> Rationale of this study was to determine the clinical patterns of epilepsy in infants from first to six months of life and their EEG findings as there is paucity of literature and published data on this aspect in infants in Pakistan. The aim of this study was to determine the spectrum of EEG in infants under six months of age having seizures to diagnose and manage them properly in tertiary care centers.

## METHODOLOGY

It was a cross-sectional study conducted in the Pediatrics Medicine Department, Shaikh Zayed Hospital, Lahore and Sir Ganga Ram Hospital, Lahore from August, 2018 till July 2019. Total of 142 cases was included by using 95% confidence level and 8% margin of error with an expected frequency of abnormalities 37.84%.<sup>1</sup> Infants under 6 months age of both genders which were newly diagnosed having first episode of seizures recruited by non-probability purposive sampling. Patients with no seizures, any central nervous system abnormalities like meningo-myelocele, spina bifida, encephalocele, microcephaly and already taking antiepileptic drugs were excluded. Patients with dysmorphism suggestive of a syndrome

or history of congenital heart disease, metabolic disorders or sepsis were also excluded in this study. After approval by the hospital ethical committee (F.39/NHRC/IRB-430) and written informed consent from parents, the data was collected through a pre-structured questionnaire. Demography of study participants like age, gender, socioeconomic status and education level of parents as well as family history of epilepsy was recorded. Classification was done as generalized, focal (with preserved or impaired awareness secondary generalized), epileptic syndrome and undetermined. Epilepsy was labelled in a patient with any of the following conditions, at least two or more unprovoked seizures occurring 24 hours apart or one unprovoked seizure with either second such seizure. Epileptic syndrome was labelled as one or more specific seizure types at specific age of onset with specific EEG changes and prognosis.<sup>10</sup> In order to record EEG, electrodes were placed according to the transverse and longitudinal montages with 10–20 systems. The patient was in a supine position on bed and relaxed. Paper speed was 30 mm/second with the time constant of 1 second. Fifteen minutes awake and 5 minutes sleep recording was taken. Photocopy and hyperventilation activation was recorded for younger infant's syrup chloral hydrate given orally and sleep recording was taken. A code was given by a number and a 'blind examiner' (one who recorded EEG without examining the patient) interpreted the report. We classify EEG as normal, abnormal focal, generalized and undetermined.

**Statistical Analysis:** Data was entered and analyzed by using SPSS 23. Frequencies and percentages were expressed for qualitative variables like gender, types of epilepsy and EEG reporting. Quantitative variables like age were presented in Mean±SD. Proportions are compared by Chi-square. P value <0.05 is considered as significant

## RESULTS

Total 142 cases were enrolled in the study according to selection criteria. The age range was one to six months with Mean±SD of age as 3.18±1.90 months. Out of 142 cases, 97 (68%) were male and 45 (32%) were female, 42 (30%) cases had family history of epilepsy positive while 100 (70%) had no such history (see Table no. 1). When patients were classified according to pattern of seizures, 101 (71.1%) had generalized seizures, 23 (16.2%) had focal partial seizures, 1 (0.7%) had epileptic syndrome and 17 (12.0%) had unclassified seizures (Table no. 2). Upon EEG reporting, there were 23 (16%) patients who had

abnormal focal reporting while 119 (84%) had no abnormal focal reporting of EEG, 16 (11%) patients had abnormal generalized frequency and 126 (89%) patients had no abnormal generalized frequency and 101 (71%) patients had normal EEG reporting while only 41 (29%) patients had abnormal reporting of the

**Table 1: Demographics of patients with epilepsy (n =142)**

Parameters		Frequency of Patient (%age) n =142 (100%)
AGE (In months)	1 – 2	76 (53%)
	3-4	18 (13%)
	5-6	48 (34%)
Sex	Male	97 (68%)
	Female	45 (32%)
Family History of epilepsy	Yes	42 (30%)
	No	100 (70%)

**Table 2: Pattern of Clinical Seizures presentation (n=142)**

Seizure types	Frequency of Patient (%age)
Generalized Seizures	101 (71.1%)
Focal Seizures	23 (16.2%)
Epileptic Syndrome	1 (0.7%)
Unclassified Seizures	17 (12.0%)
Total	142 (100%)

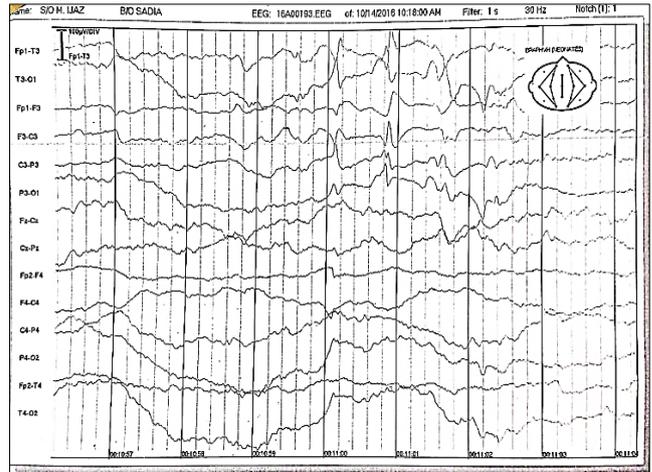
**Table 3: Stratified for clinical pattern of epilepsy with EEG findings (n=142)**

EEG reporting	Yes	No
Abnormal focal (High amplitude sharp waves at any region of unilateral hemisphere)	23 (16%)	119 (84%)
Abnormal generalized (Abnormal high amplitude short waves appeared in both hemispheres mostly at the temporoparietal region)	16 (11%)	126 (89%)
Undetermined (Finding consistent with hypsarrhythmia abnormal interictal high amplitude waves and a background of irregular spikes, burst suppression pattern of abnormal waves and predominant delta and theta waves)	3 (2%)	139 (98%)
Normal	101 (71%)	41(29%)
P value	0.666	

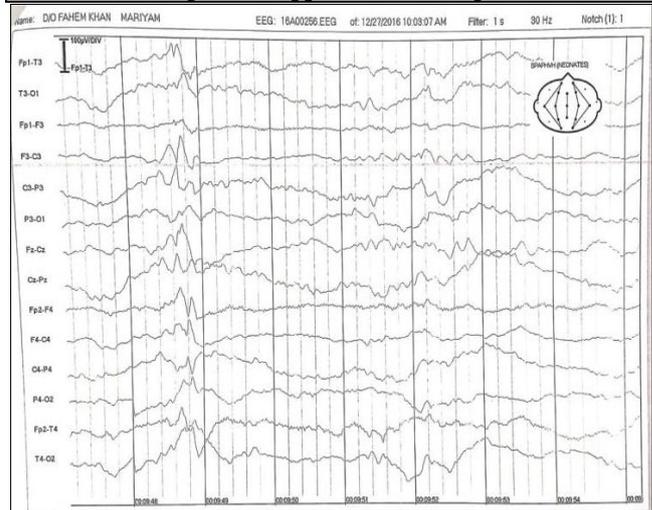
Proportions are compared by Chi-square. P value <0.05 is considered as significant.

EEG and only 3 (2%) patients had undetermined reporting of EEG and 139 (98%) children had no undetermined EEG reporting in our study (Table no. 3).Data was stratified for clinical patterns of epilepsy with EEG findings which have insignificant (p value > 0.05) that is 0.666.(Table no. 3)

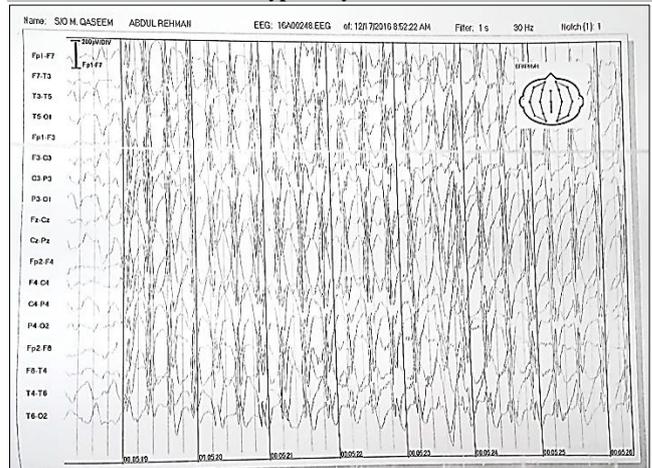
**Fig 1. Focal interictal epileptic discharges with suppression over left hemisphere.**



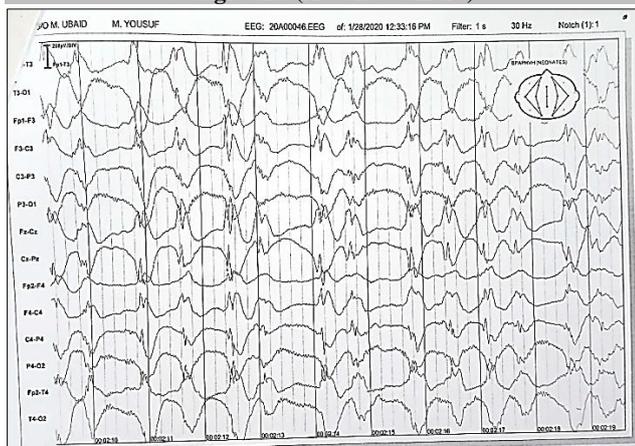
**Fig 2. Abnormal EEG due/ Interracial Epileptiform discharges and suppression of background.**



**Fig 3. Disturbed background with multifocal spike and generalized burst of spike and wave activity followed by electro decremental responses and suppression is suggestive of modified Hypsarrhythmia.**



**Fig 4. Generalized burst of 3Hz spike and wave activity of high voltage lasting about 8-10 seconds with normal background (Absence seizure).**



## DISCUSSION

The misdiagnosis rate of epilepsy is very high as compared to other diseases so in order to diagnose it, EEG findings must be reported. Proper history of abnormal movements, altered levels of consciousness with detailed neurological examinations are essential for the diagnosis of epilepsy but to confirm these diagnosis, EEG is very important. But on the other hand normal EEG recording does not exclude epilepsy as shown in previous studies that about 10% of epileptic patients never show abnormal discharges on EEG. At the same time abnormal EEG occurred in non-epileptic patients.<sup>9</sup> An epileptic syndrome diagnosis is based on specific seizures types at specific age of onset and specific prognosis. By diagnosing epilepsy, management and prognosis are better defined.<sup>12</sup> In this study, the mean age of patients was  $3.18 \pm 1.90$  months. Half of these were between 1-2 months of age. A study conducted by MA Khalily showed the children with mean age of  $5.58 \pm 3.46$  years were noted with clinical seizures.<sup>5</sup> In our study, epilepsy was dominant in males compared to females (2.1:1). This is in agreement with Rajper et al.<sup>9</sup> In this study, 71% patients were with generalized epilepsy followed by focal (16.2%) and unclassified seizures (12%). In the study conducted by MA Khalily there were 56.8% patients having generalized, 23.5% focal, and syndromic epilepsy in 4.9% of patients which are comparable to our study.<sup>5</sup> In another study mostly patients had unclassified seizure (61.2%) found followed by generalized seizure (29.5%) and partial seizure (9%). The current study showed almost one third patients with epilepsy had abnormal EEG findings. Similar results have also been reported by Ostwal who observed low yield of abnormal EEG

(19% and 32.2% respectively).<sup>13</sup> Other studies showed that EEG abnormality was seen in more than 50% of patients.<sup>10,14</sup> Abnormal generalized epileptiform discharge was seen in 11% of our respondents. A study by Joshi revealed abnormal EEG in 43.3% with generalized epilepsy diagnosed on EEG in 26.21%<sup>15</sup>.

**Limitations of the study:** Limitation of the study is that sample size was small and under six months infants were included, and it was done only in two centers so we further recommend that further similar studies should be conducted in different settings with different protocols and include different age groups.

## CONCLUSION

Almost one third of patients with epilepsy had abnormal EEG. It is a simple and relatively inexpensive test that should still be used in patients to support the diagnosis of epilepsy. There is no standard operative protocol for the treatment of epilepsy, we can tailor management according to history and clinical condition of the patient. EEG may be helpful in choosing appropriate antiepileptic drugs to minimize adverse effects and drug interactions, thereby improving patient care.

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#### *Author's Contribution:*

<b>Dr. Lubna Riaz</b>	Conceived Idea, Manuscript, Writing, Statistical Analysis and Final review and approval of manuscript
<b>Dr. Waqas Shafique</b>	Study design, Data Collection and Review and approved manuscript.
<b>Dr. Neelam Faryad</b>	Study design, Data Collection and Review and approved manuscript.
<b>Dr. Fouzia Ishaq</b>	Statistical Analysis, Data Interpretation and Final approval.
<b>Dr. Naveed Shahzad</b>	Statistical Analysis, Data Interpretation and Final approval.
<b>Dr. M. Ali Sheikh</b>	Result Interpretation, writ up of results review and approved the manuscript.
	All authors are equally accountable for research work and integrity

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